Learned and Innate behavior

Class outlines

1. What is innate behavior ?
    Example #1: Knee-jerk reaction; facial expression
    Example #2: Egg rejection in brood parasites
    --Releaser (sign stimulus)
    --Supernormal stimulus
    --Fixed action pattern

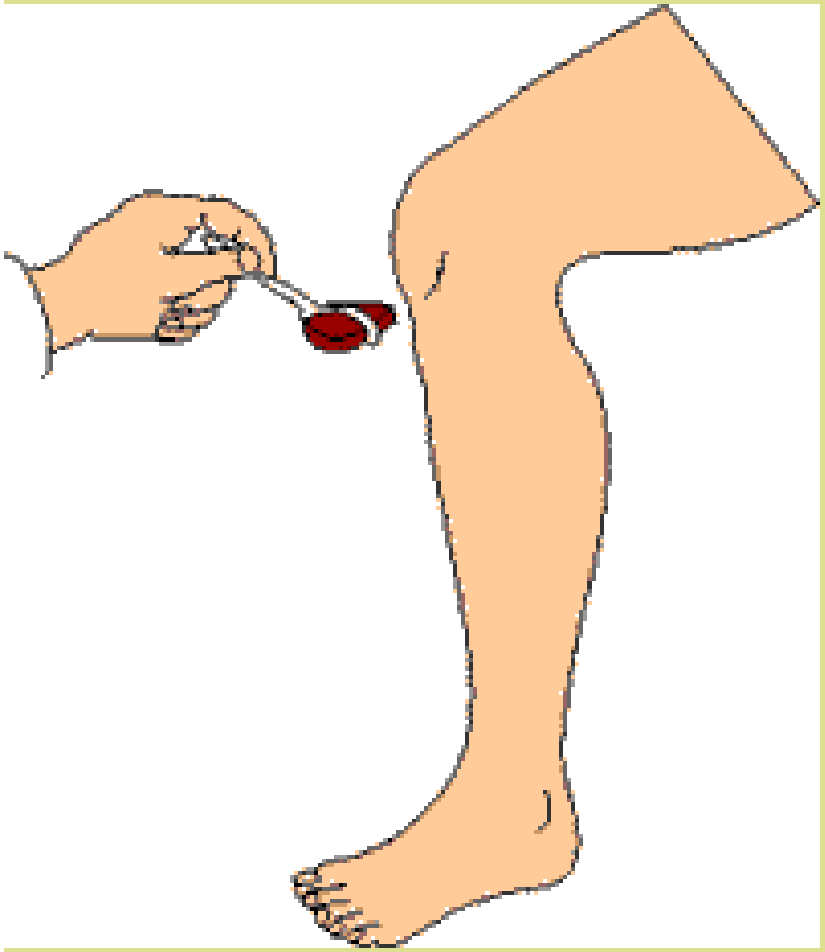
2. What is learned behavior?
    Example: play instruments; sports, language learning
    a. Associative learning
    b. Imprinting
        Filial imprinting
        Sexual imprinting

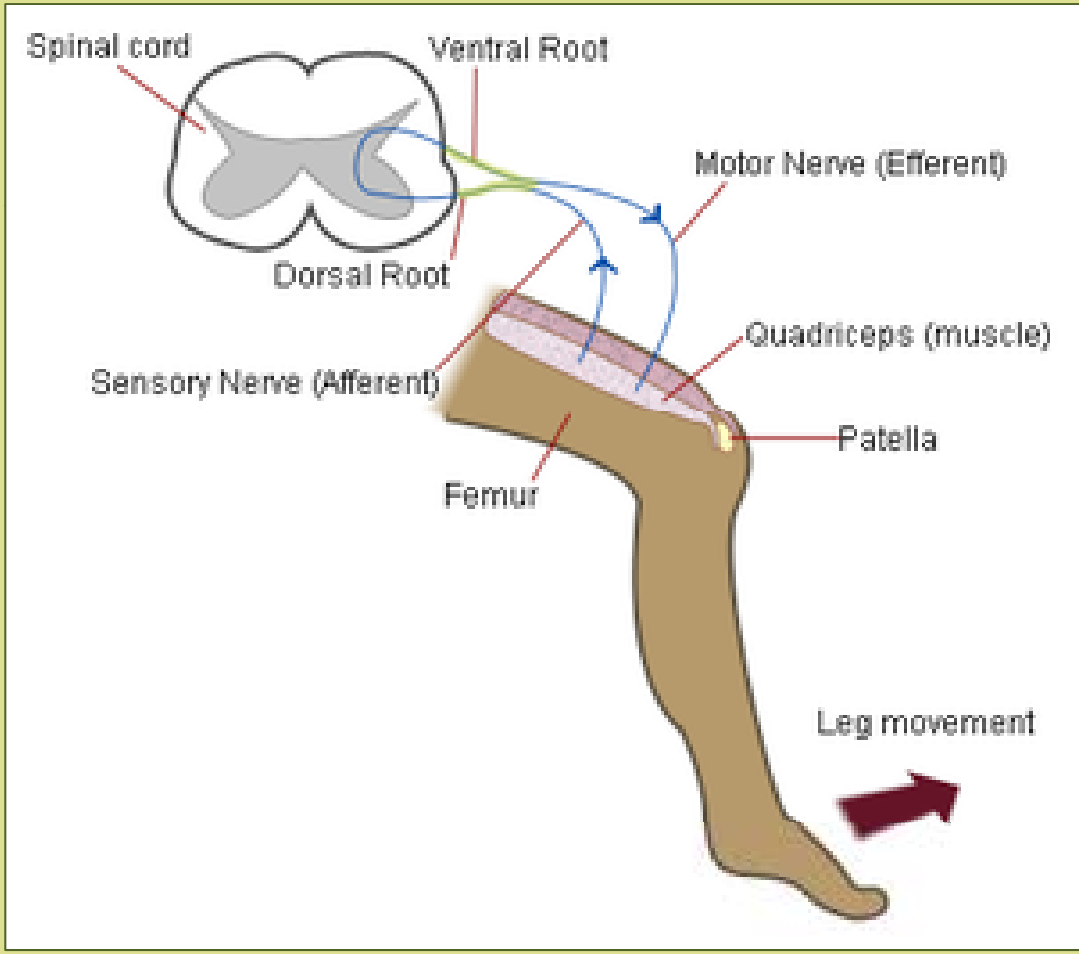
What is innate behavior?

- Fixed
- Stereotyped
- No experience required

What is innate behavior?

- Knee-jerk reaction (patellar reflex)





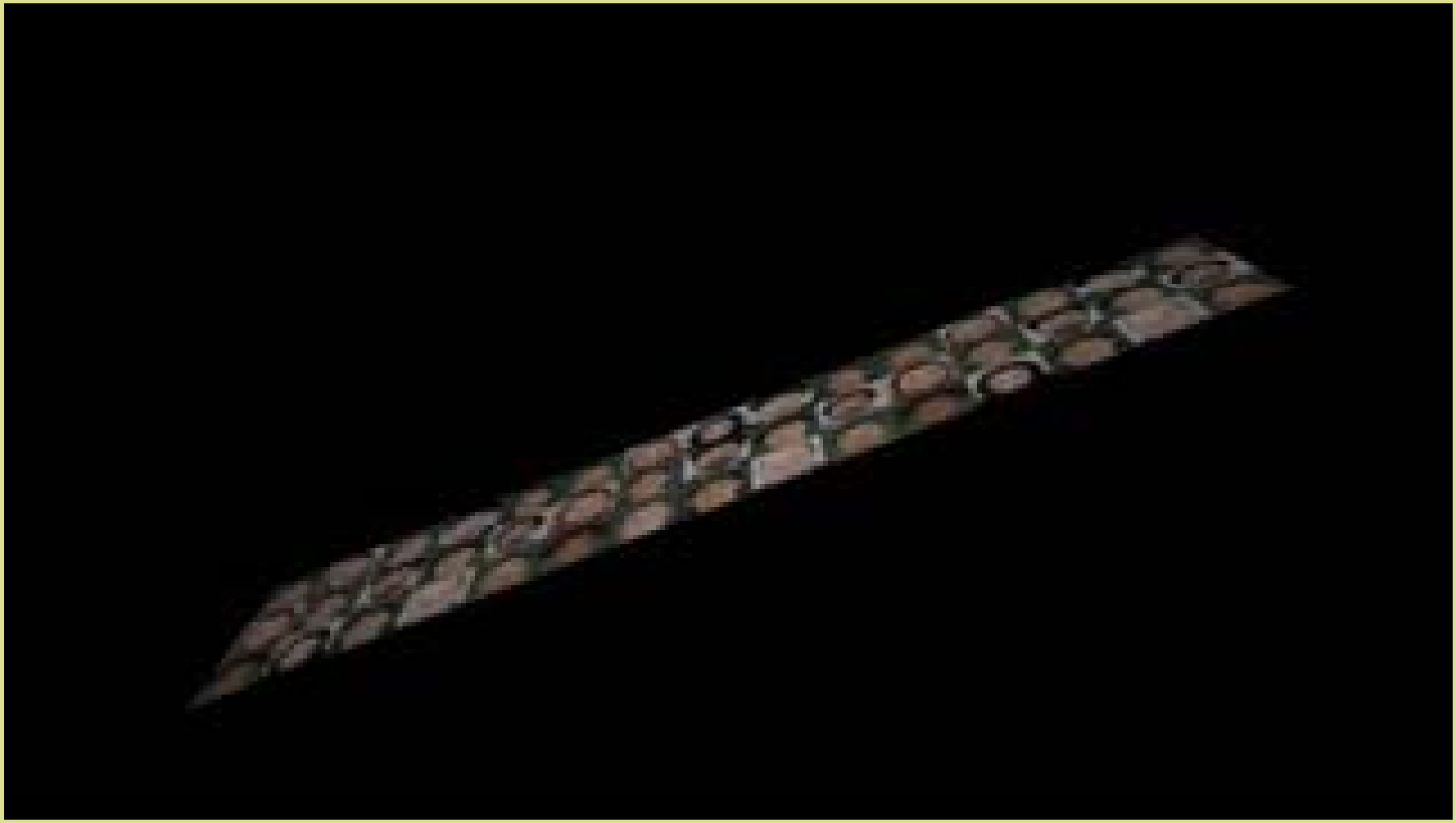
innate behavior

Brood-parasitic cuckoo and its host parent (Reed warblers)

Egg-ejection

Facial expression in humans: innate?

Design an experiment to demonstrate that facial expression is innate?



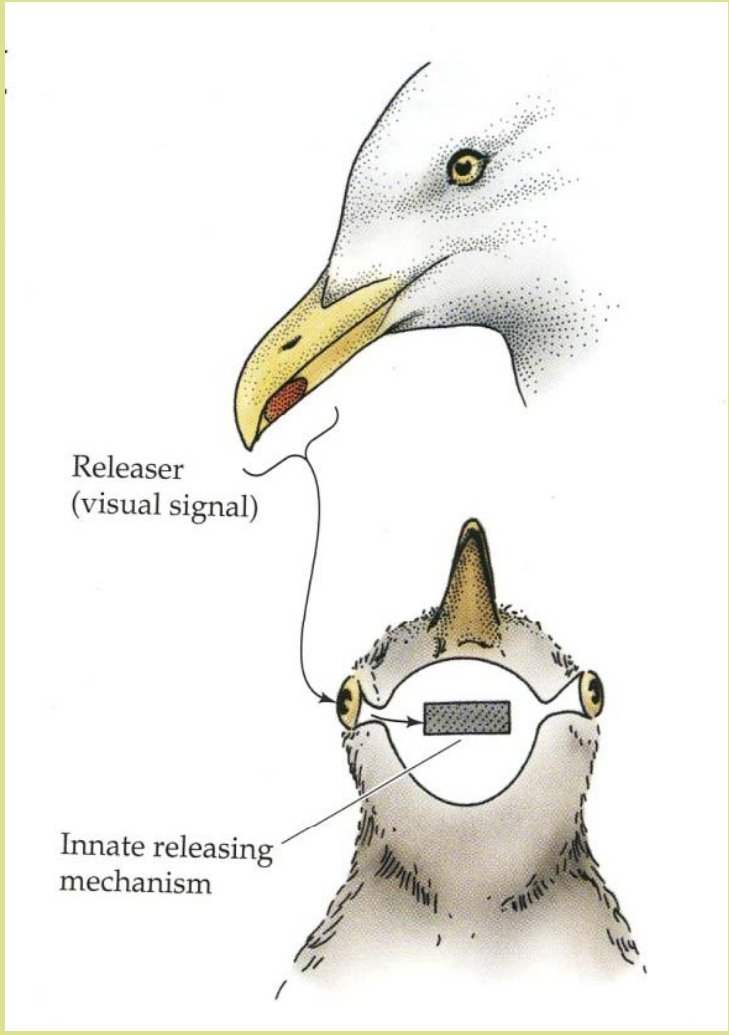
Study facial expression of blind people

Some innate behaviors are elicited by releasers (or sign stimulus)

Parent's beak as a releaser?

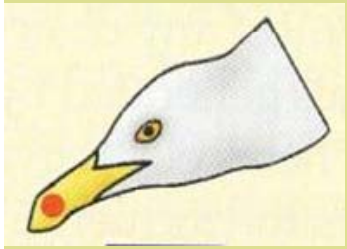
Herring Gull

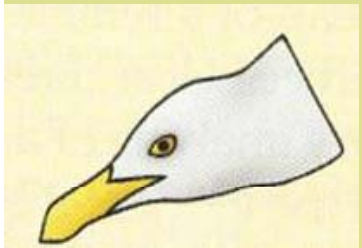
(study by Tinbergen)

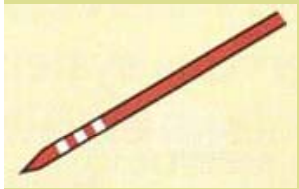


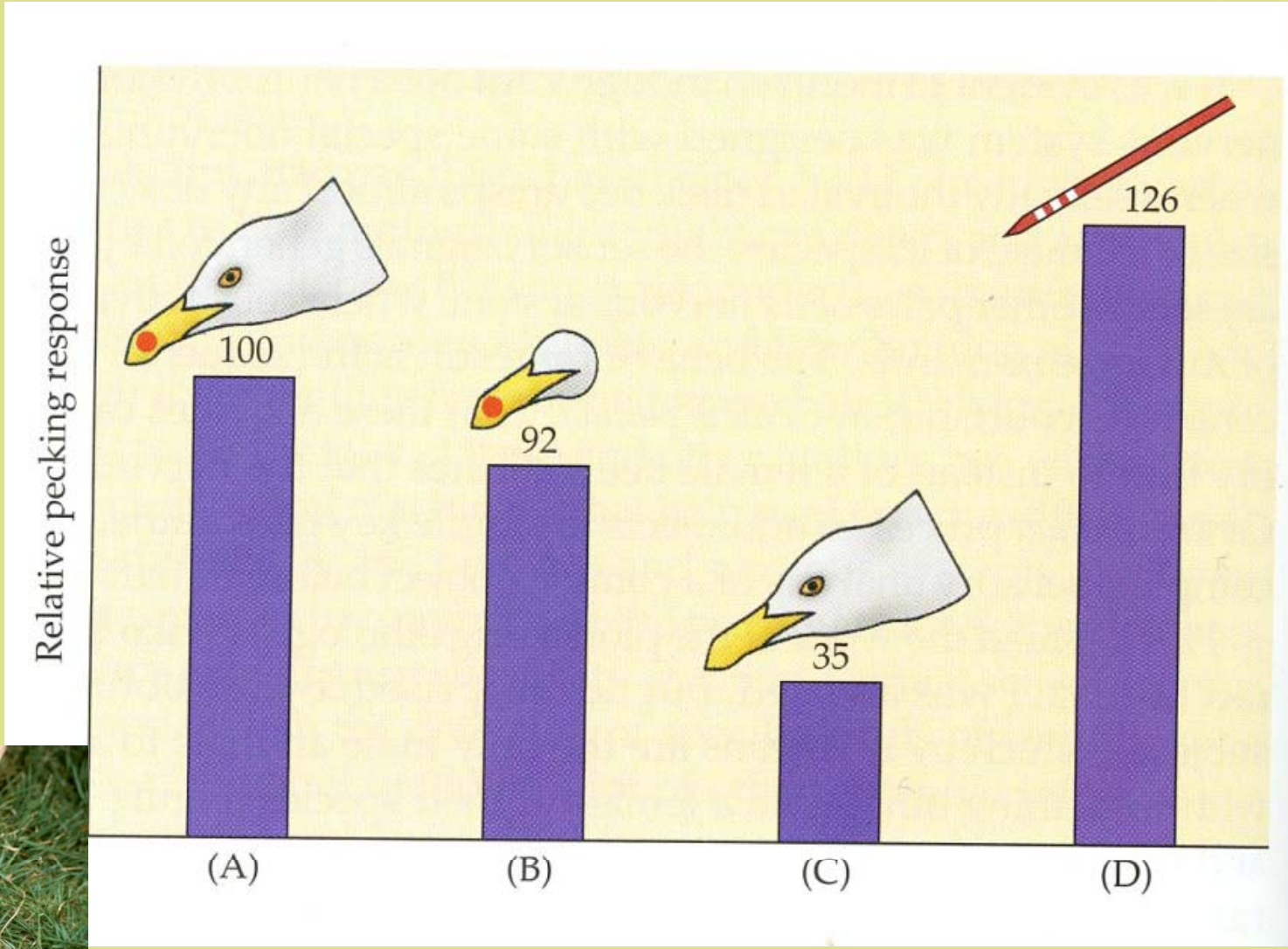
Red spot (releaser) induces innate begging behavior

Experiment: parent's red-patched beak as a releaser?

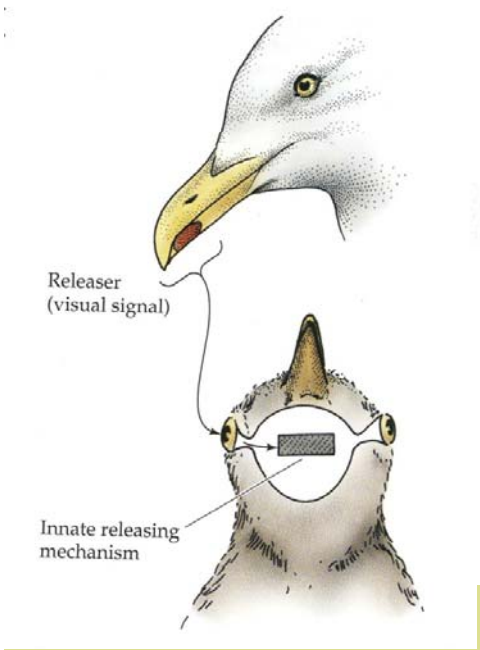


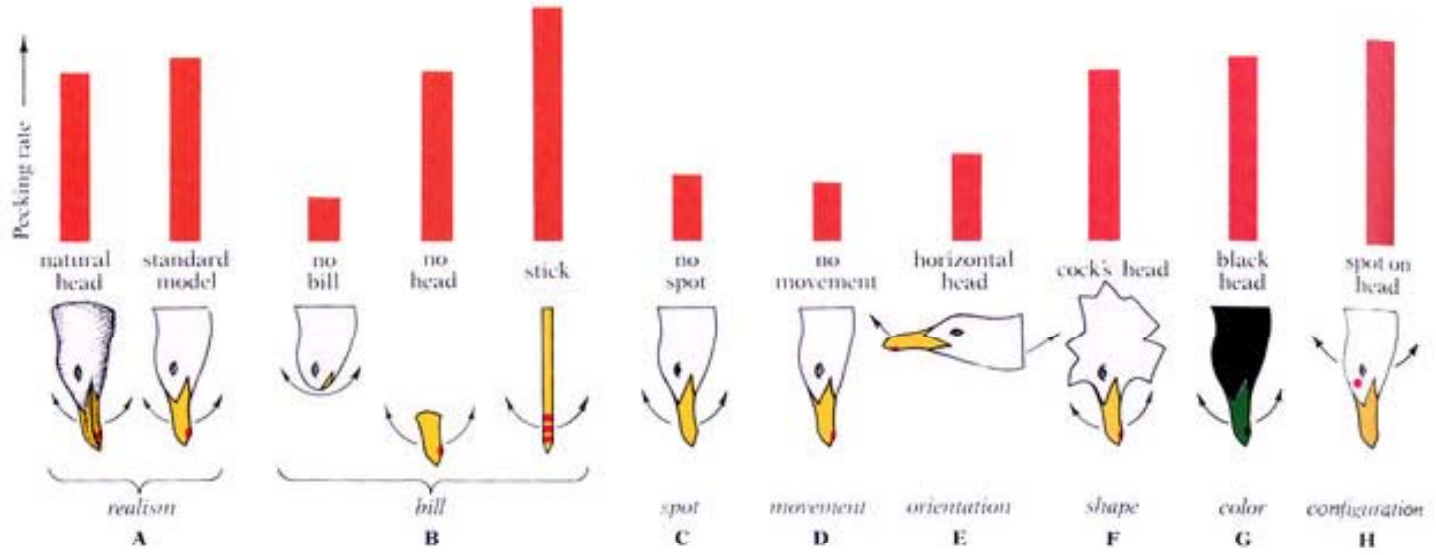






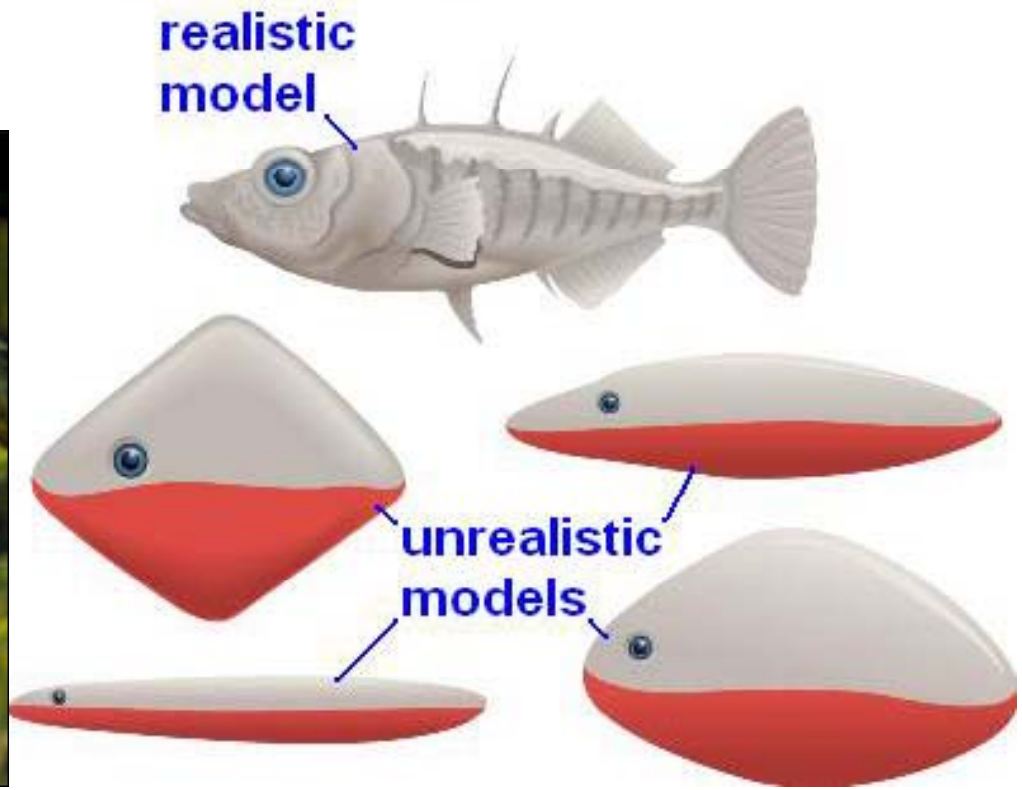
Experiments to test what is the releaser in begging behavior





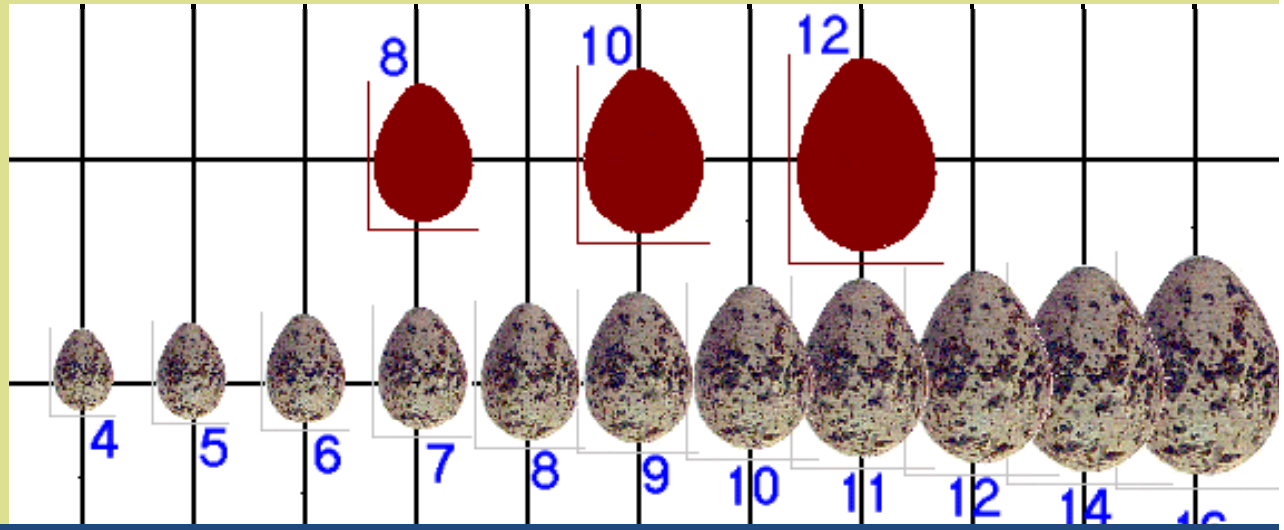
Color contrast induces innate begging behavior

Releaser in stickleback's innate, aggression



What is the releaser here?

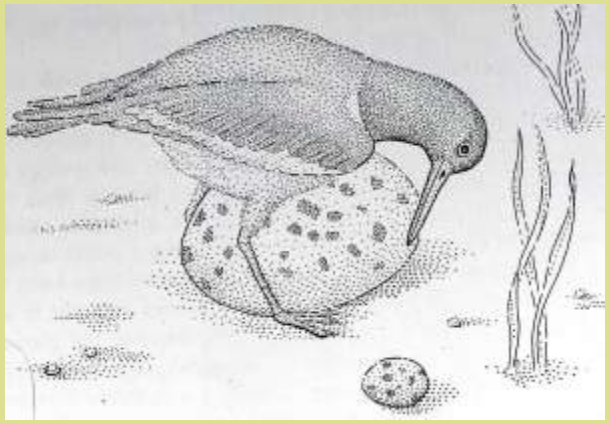
Supernormal stimulus (releaser)?



What size of eggs the parent gulls prefer sitting?

1. Smaller than theirs
2. Exact the same size of theirs
3. Slightly larger than theirs
4. MUCH larger than theirs
5. Size does not matter, egg color is

Supernormal stimulus (releaser) parent birds prefer super-big egg

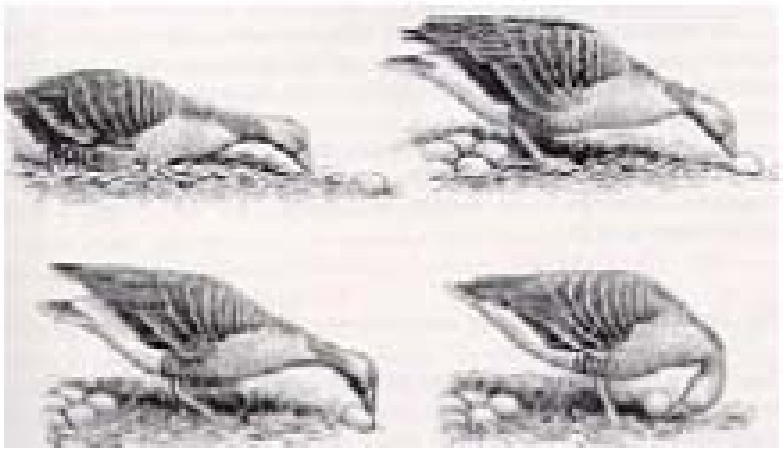


Supernormal stimulus (releaser)? parents prefer bigger babies

Innate Behavior: Fixed action pattern

an instinctive behavioral sequence that is indivisible and runs to completion

Egg-rolling in greylag geese
(Lorenz & Tinbergen, 1939)



Graylag Goose

Goose continues to ‘roll’ egg into nest even though egg has been taken away

Innate: Fixed action pattern

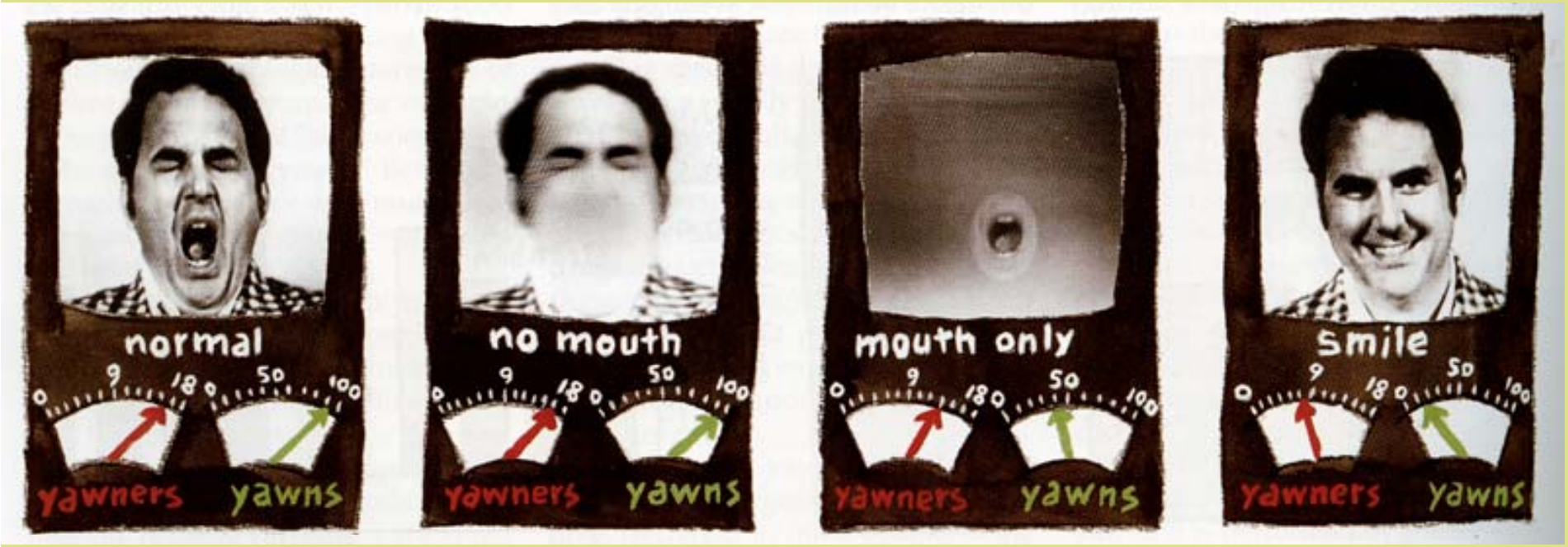
Innate behavioral sequence: runs to completion

Yawning: fixed action pattern

Yawning is contagious

what is the releaser?

What features of yawning trigger yawning? (what is the releaser?)



Why animals yawn, its function? (ultimate)

Why yawning trigger yawning?

Summary: Innate behavior

1. examples: knee-jerk reaction; facial expression; parasitic cuckoos; egg-rolling; yawning
2. releaser (sign stimulus)
3. supernormal stimulus
3. fixed action pattern

What is learned behavior?

- Modifiable (flexible)
- Experience-dependent
- Practice (error correction)
- Memory

What is learned behavior?

What is learned behavior?

Learned behaviors in animals:

1. associative learning
   (conditioning)
   a. classical conditioning
   b. operant conditioning

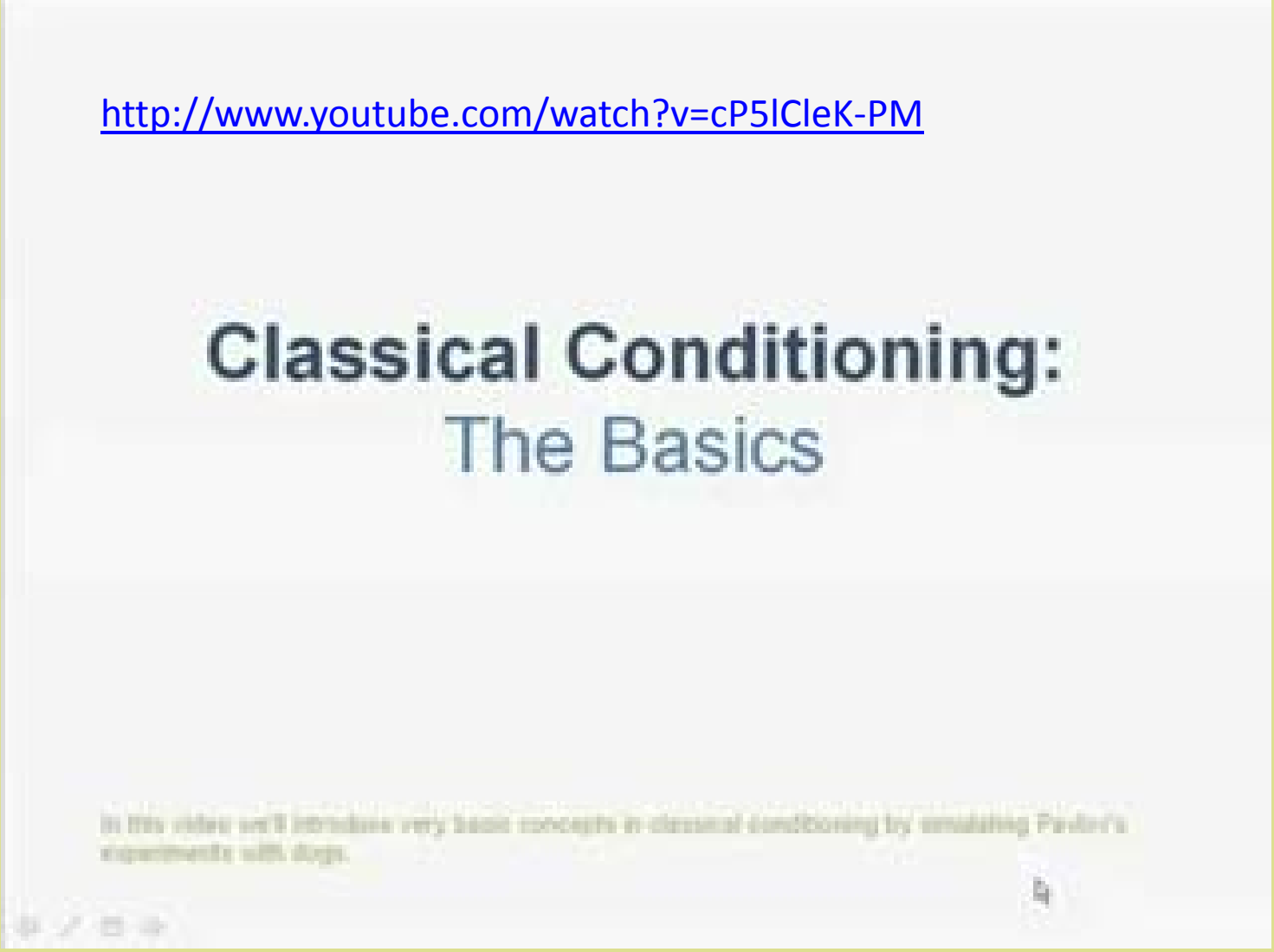
1. Associative learning
(conditioning)

a. Classical conditioning

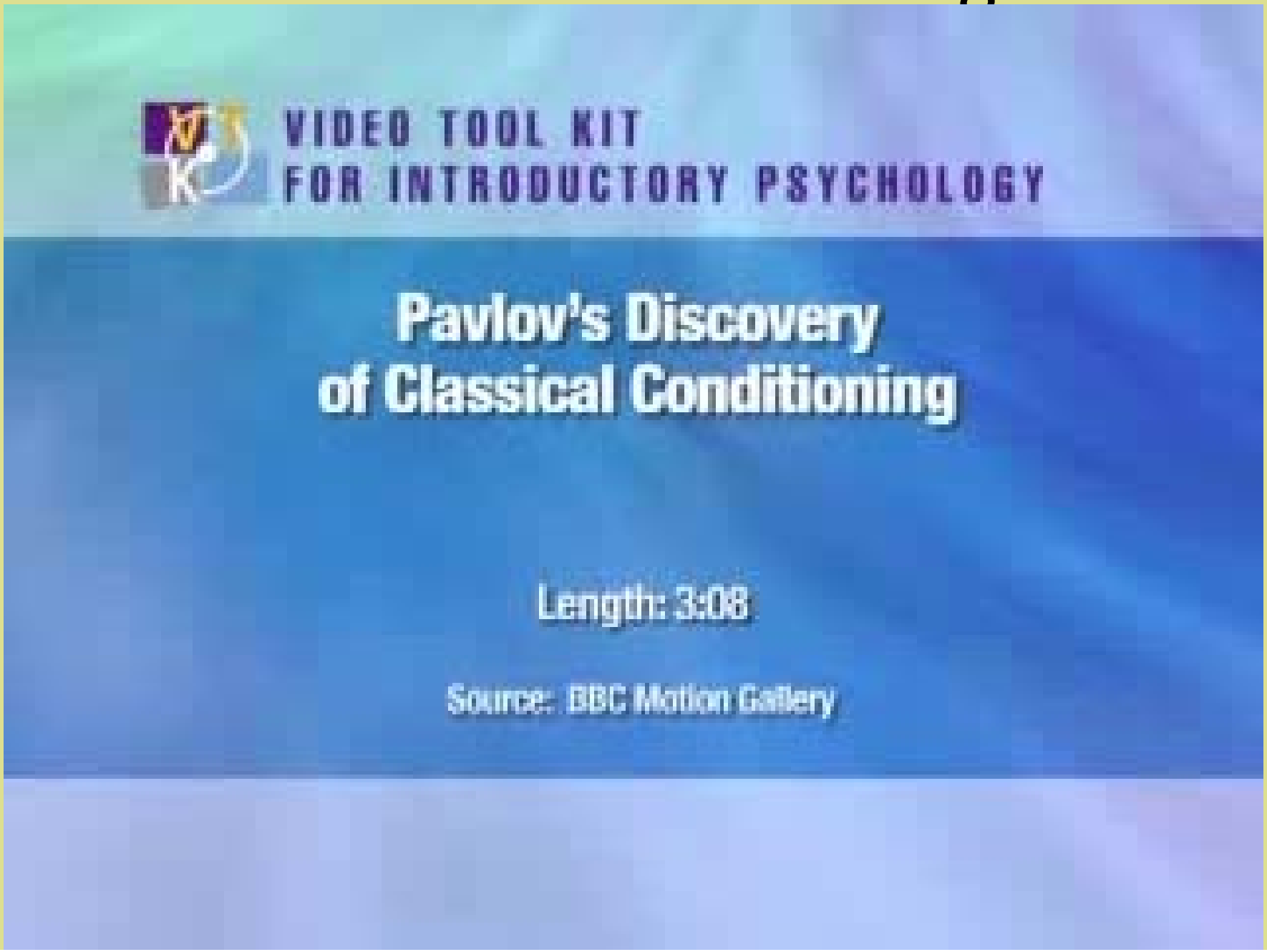
Learned process that occurs through association between an environmental stimulus and a naturally occurring response.

Learned behaviors in animals: Classical conditioning

http://www.youtube.com/watch?v=cP5lCleK-PM



Classical conditioning



Classical conditioning

define…

1. Neutral stimulus
2. Unconditioned stimulus
3. Unconditioned response
4. Conditioned stimulus
5. Conditioned response

2. Operant conditioning

An animal modifies (operate) its own behavior based on the consequence of the behavior (punishment or reward-reinforcement)


http://www.youtube.com/watch?v=MOgowRy2WC0

Operant conditioning

Rats

1. press the lever
2. light on (associate with the lever)
3. get the reward (associate with food)

Are they conditioned?

Are they conditioned?

GAP

JCPenney

macy's

Learning behavior:
2. Imprinting

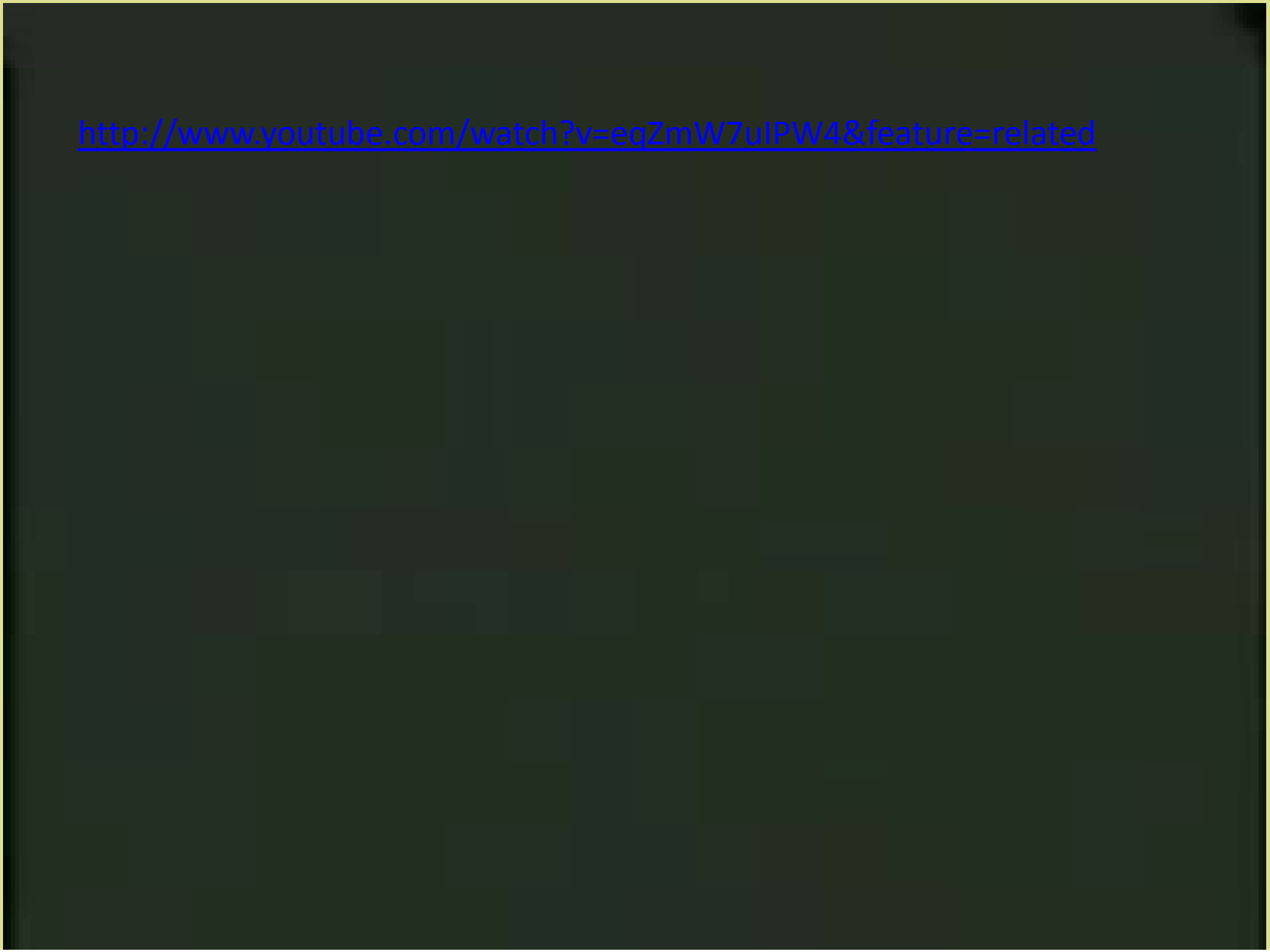
Phase-sensitive learning
(learning occurs at a particular age or life stage)

1. Filial imprinting
2. Sexual imprinting

1. Filial imprinting

a young animal acquires several of its behavioral characteristics from its parent.

Filial imprinting (Konrad Lorenz)



Filial imprinting

Critical period : the hatchlings identify any moving object they first encounter as parents during the first 13-16 hours after hatching.

Imprinting

1. Learned from experience in early life
2. Has a critical period for learning
3. irreversible

Why not innately identify parents? Why imprint?
-- more flexibly find care-taker or resources.

Filial Imprinting
-early experience dependent learned behavior

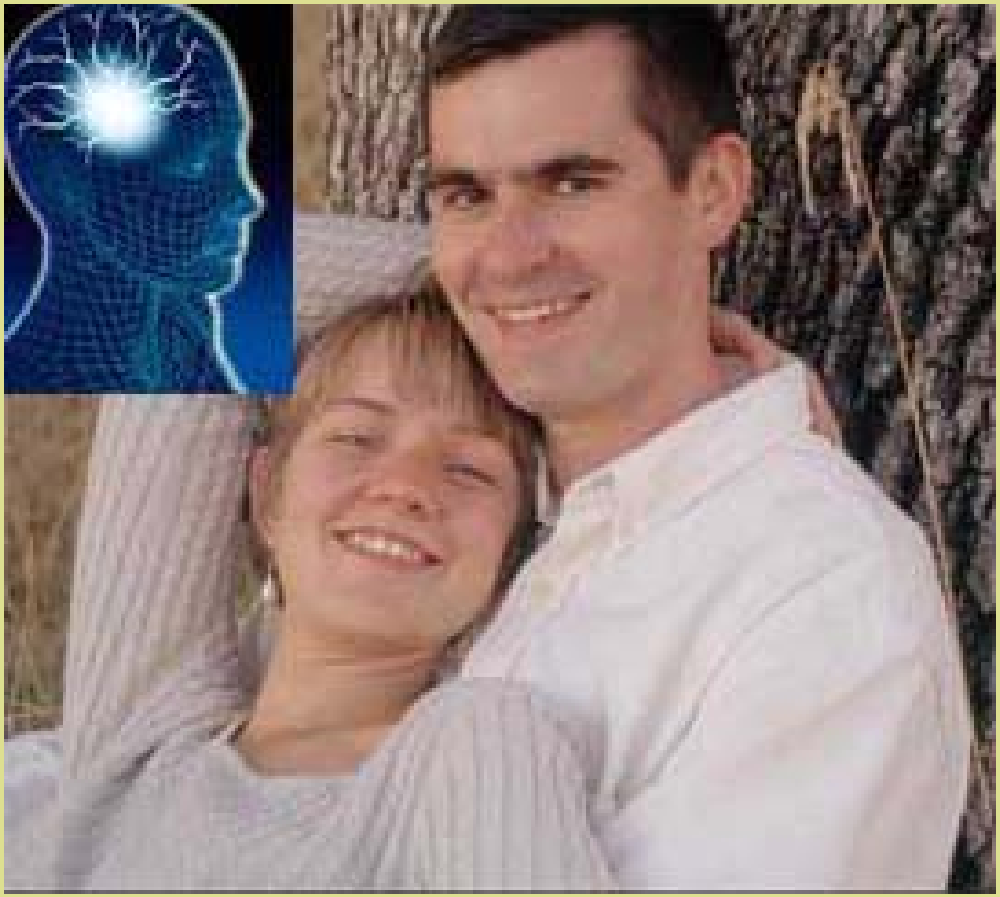
Sexual imprinting

a young animal learns the characteristics of a desirable mate from the one who raise it.

Sexual imprinting

Male (father) zebra finch looks different among individuals, Its daughter imprint the father's "look", later choose a mate that looks similar to its father (but not exactly the same)

Sexual imprinting in humans



Humans tend to choose mates by imprinting on their parents' look and early childhood experience

Sexual imprinting in humans

Sexual imprinting in human mate choice

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Animal and human studies have shown that individuals choose mates partly on the basis of similarity, a tendency referred to as homogamy. Several authors have suggested that a specific innate recognition mechanism, phenotypic matching, allows the organism to detect similar others by their resemblance to itself. However, several objections have been raised to this theory on both empirical and theoretical grounds. Here, we report that homogamy in humans is attained partly by sexual imprinting on the opposite-sex parent during childhood. We hypothesized that children fashion a mental model of their opposite-sex parent's phenotype that is used as a template for acquiring mates. To disentangle the effects of phenotypic matching and sexual imprinting, adopted daughters and their rearing families were examined. Judges found significant resemblance on facial traits between daughter's husband and her adoptive father. Furthermore, this effect may be modified by the quality of the father–daughter relationship during childhood. Daughters who received more emotional support from their adoptive father were more likely to choose mates similar to the father than those whose father provided a less positive emotional atmosphere.

Reading Quiz #2

1. Human version of FoxP2 gene differs from those of chimps and gorillas by _____ amino acids ?
   a) 2; b) 20; c) 200; d) 2000; e) none

2. What animals have FoxP2 gene?
   a) humans; b) birds; c) bats; d) rats; e) all of them

3. What does FoxP2 do in humans?

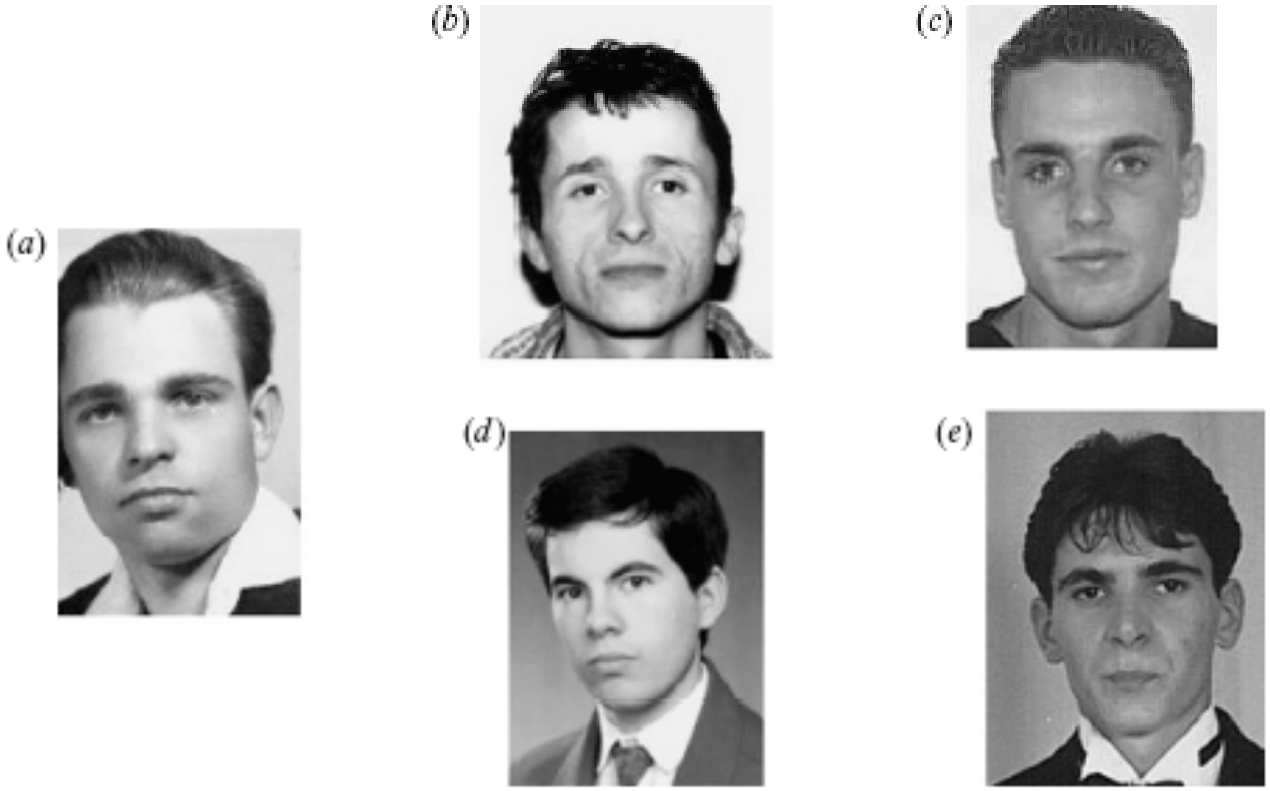


Figure 1. The tableau shows adoptive father when his daughter was between 2 and 8 years old (*a*) and four possible sons-in-law (*b*)–(*e*). Subjects were asked to make an assessment about the rank of similarity between them. The appropriate match was (*d*).

In this study, why were "adoptive father" used, not genetic father?

To rule out the possibility that the daughter preference is not due to "innate" genetically predisposed preference – "phenotype matching"

Learned behavior in animals

1. Associative learning
   - Classical conditioning
   - Operant conditioning
2. Imprinting
   - Filial imprinting
   - Sexual imprinting
3. Complex learning in animals?

Tools using in crows

New Caledonian Crows

Corvus moneduloides

Dr Gavin Hunt
Dr Russell Gray
Dept of Psychology
The University of Auckland
Auckland, New Zealand

Complex tool use in chimpanzees

Summary : Learned behavior

1. Definition and Examples:
2. Associative learning
   - Classical conditioning
   - Operant conditioning
3. Imprinting
   - Filial imprinting
   - Sexual imprinting
4. Complex learning in animals

Learned behavior, Innate behavior

Which is more flexible?

Which is more adaptive?

Why do animals evolved innate behavior?

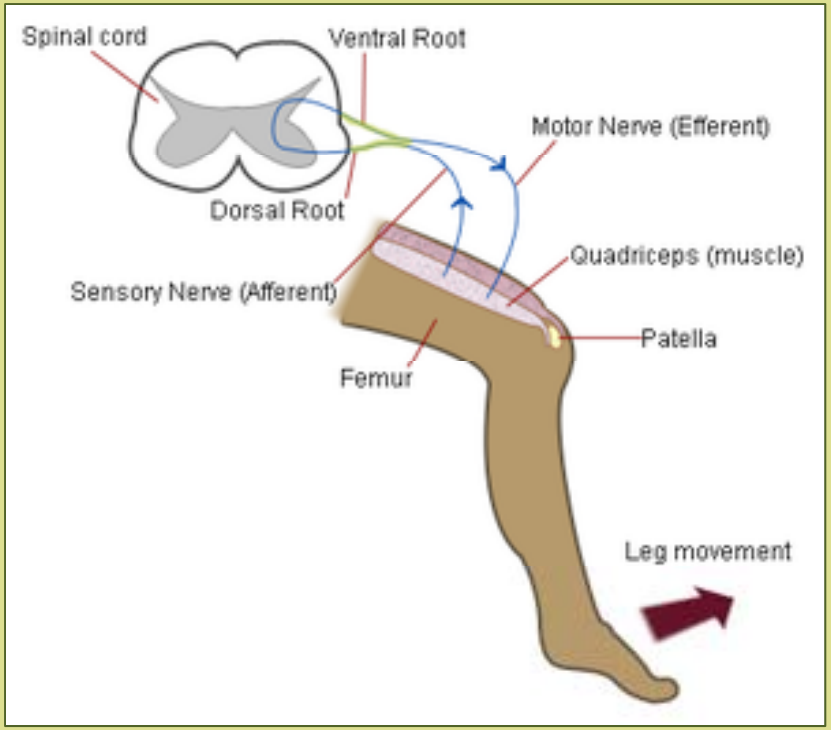
Why do animals evolved learned behavior?

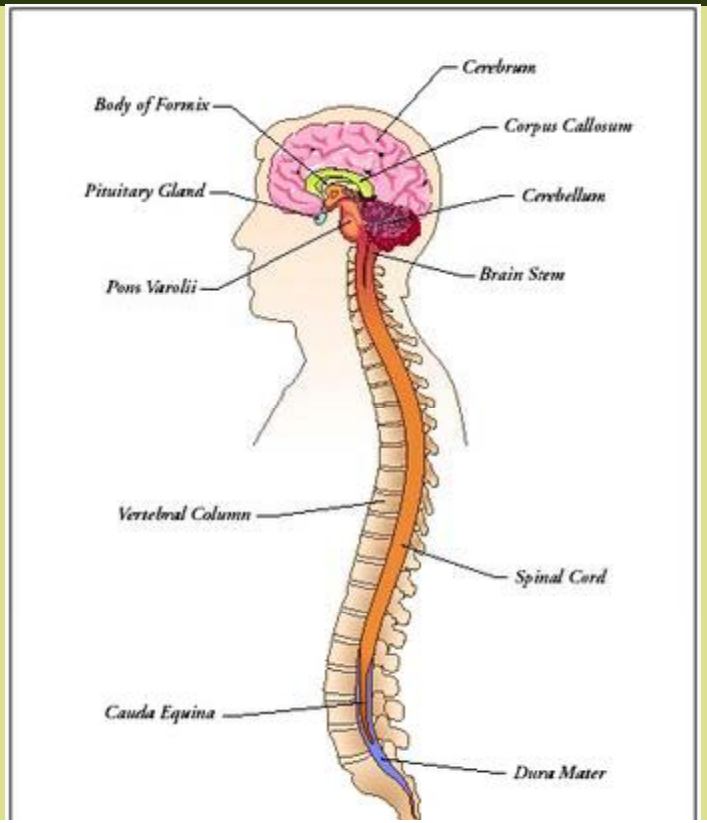
Most behaviors:

- Innate behavior can be modified (learned)
- Learning has genetic, innate basis

Innate behavior can be modified

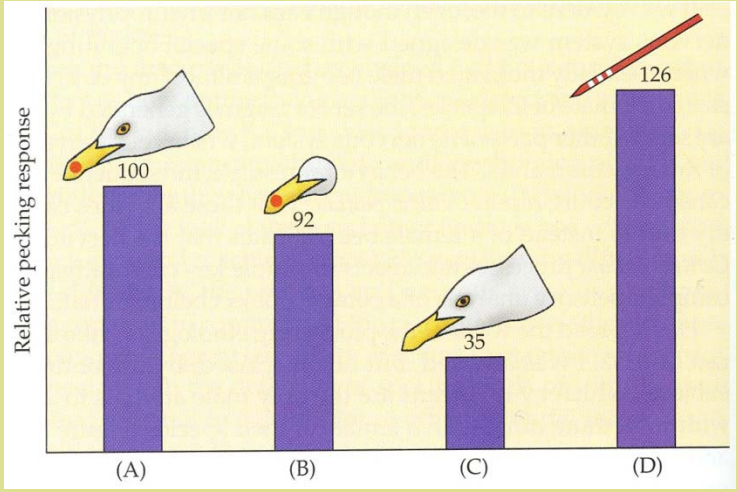
• Knee-jerk reaction: sensory signal will be later sent to the forebrain to control and modify body movement and reaction – become a learned behavior.



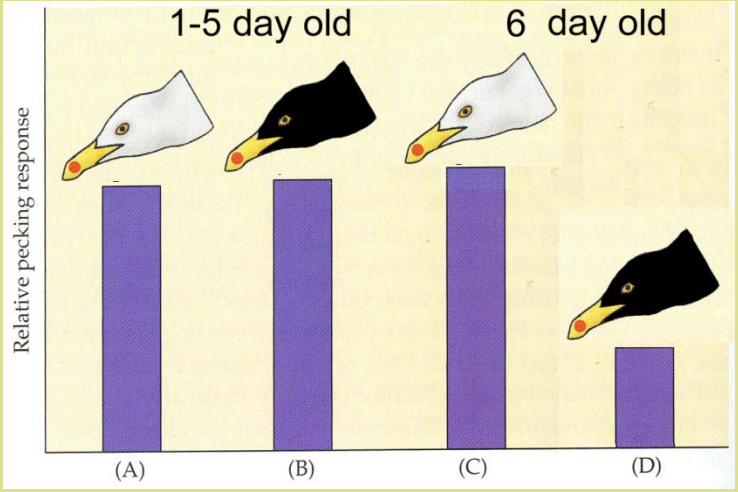


Innate or learned?

- Innate behavior can be learned.



Red dot induces innate begging
(N. Tinbergen)

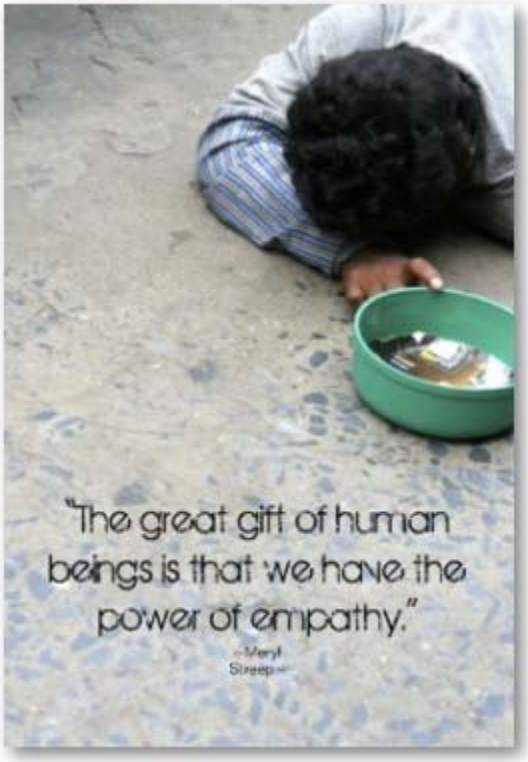


Jack Hailman (1967) : Newly hatched herring gulls do not distinguish between two models. However, at 6 days, they reliably tell the difference

Learned behavior has innate (genetic) basis

e.g., Fox P2 gene

Cognitive behavior:
Empathy: innate or learned?



Empathy: innate or learned?

A patient named Smith is undergoing neurosurgery at the University of Toronto. He is fully awake and conscious. His scalp has been perfused with a local anesthetic and his skull has been opened.
The surgeon places an electrode in Smith's anterior cingulate, a region near the front of the brain where many of the neurons respond to pain.
And sure enough, the doctor is able to find a neuron that becomes active whenever Smith's hand is poked with a needle. But the surgeon is astonished by what he sees next. The same neuron fires just as vigorously when Smith merely watches another patient being poked. It is as if the neuron is empathizing with another person.
A stranger's pain becomes Smith pain.

Here is a neuron that doesn't know the difference between self and other
Are our brains uniquely hardwired for empathy and compassion?

Case study:
Learned and innate vocalizations

Learned vocalizations in humans

1. Rare evolutionary event
2. Require auditory experience
3. Require sensitive period of development
4. Require "babbling" error-correction stage
5. Require a specialized brain area
6. Innate components of learning
7. Associated with specific genes
8. why evolve language?

A few groups of mammals and birds evolve vocal learning

* Mammals
  1. Humans
  2. Cetaceans
  3. Bats
  4. Elephants

* Birds
  1. Songbirds
  2. Parrots
  3. Hummingbirds

Only humans evolve spoken language
Chimps have no vocal learning

Speech learning requires auditory experience

In 1920, two girls, aged 8 and 18 months, were found by Rev. J.A.L. Singh in a cave in India, living with a family of wolves. Kamala was the older girl, and Amala was her infant sister. Like other children raised by animals, both girls growled, uttered sounds that were not speech, and had all the behaviors of their wolf caretakers.

Experiments to test auditory experience is required for speech learning?

Speech learning requires development (error correction process)

Infant babbling

Babbling of a 1.5-year-old infant

“bow wow wow wow va wa….wee wee wee…

m hi daddy ba ma ba wow wa wa…. Den da daddy daddy!”

Kroodsma 1972

Speech learning has a sensitive period (peak <6 years old)

Learning second language (Accent):

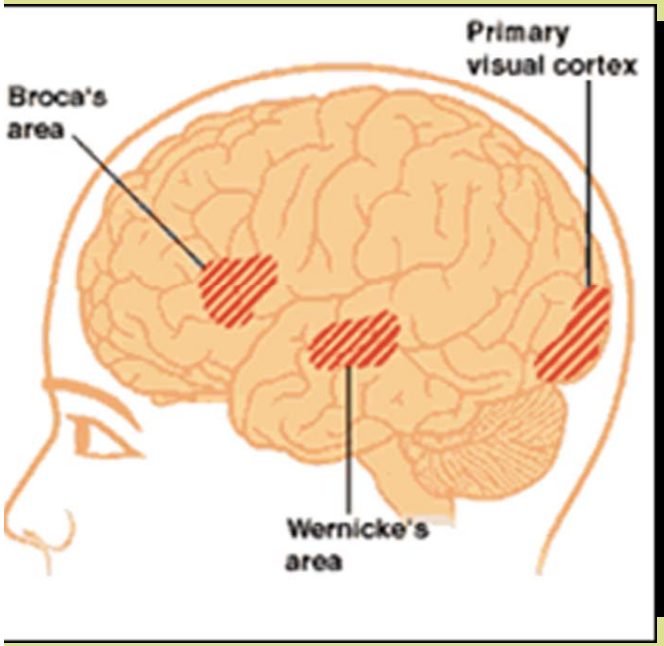
How to test of critical period in learning language?

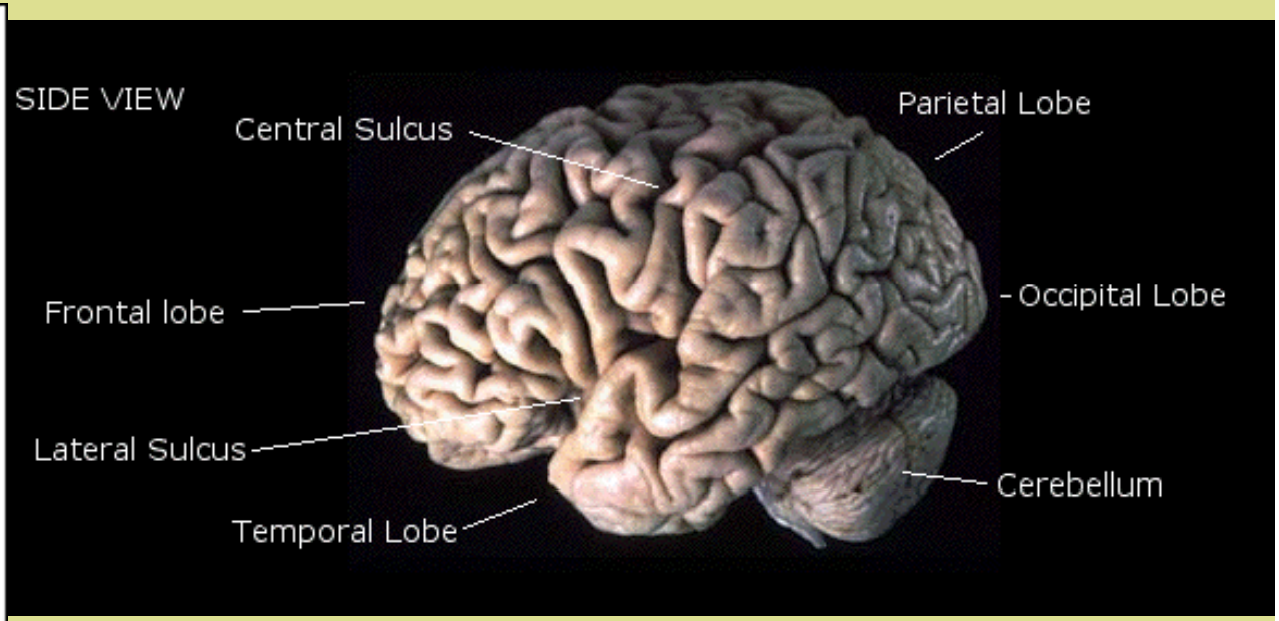
Speech learning has a sensitive period

A 13-year-old girl name Genie was discovered in Los Angeles after a childhood of almost inconceivable horror. The daughter of a blind, abused mother and a paranoid and reclusive father, she had been kept in silence in a single room, mostly harnessed to a potty chair or confined in a caged crib. She was almost completely mute. As she was passed between scientists, foster parents, state officials. Today she learned much, her intelligence was high, her nonvocal communication was extraordinary, and her ability to solve spatial puzzles was ahead of her age.

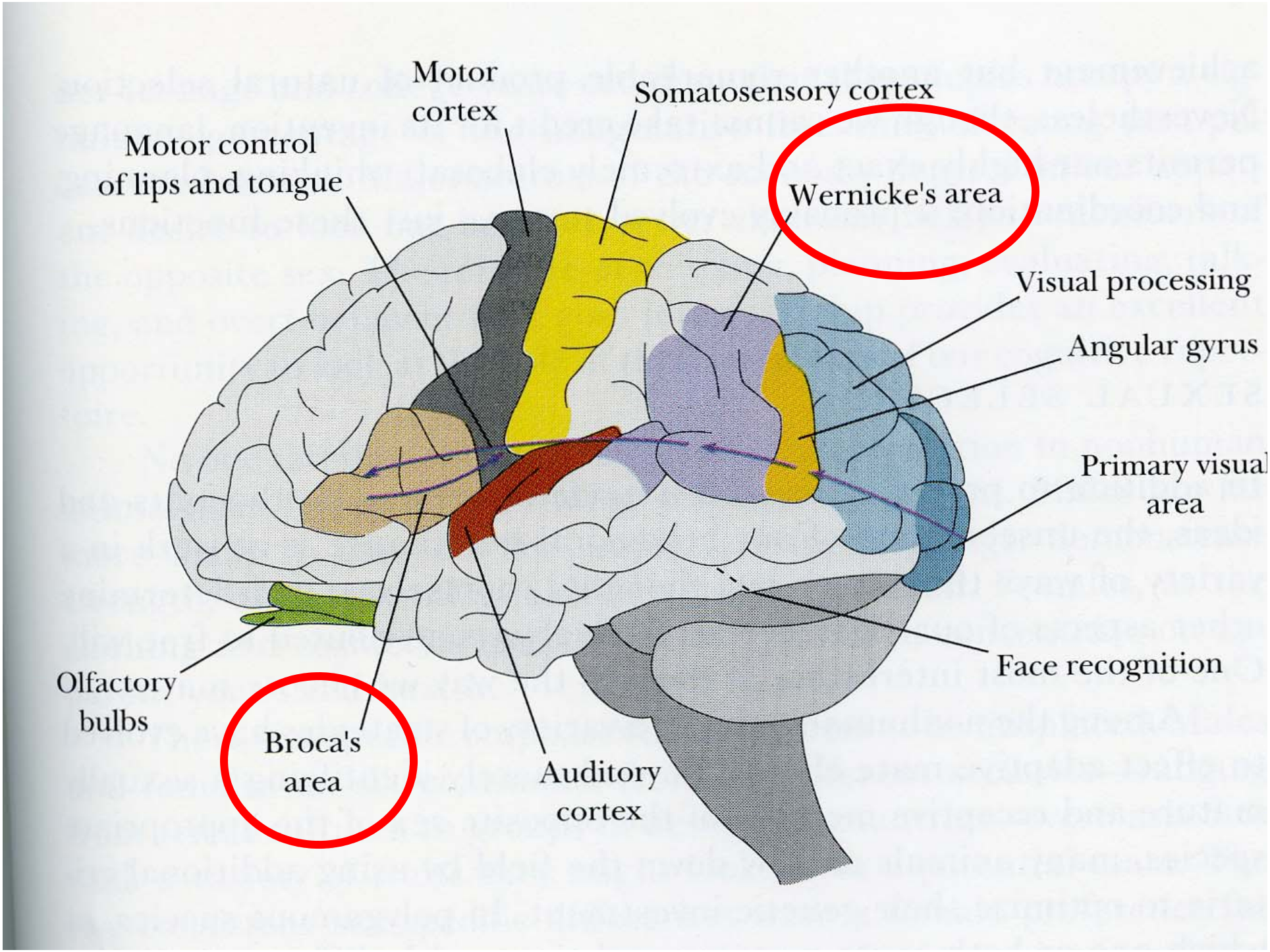
But she never learned to speak. She developed a good vocabulary. But not elementary grammar, and syntax or word order was a foreign land……

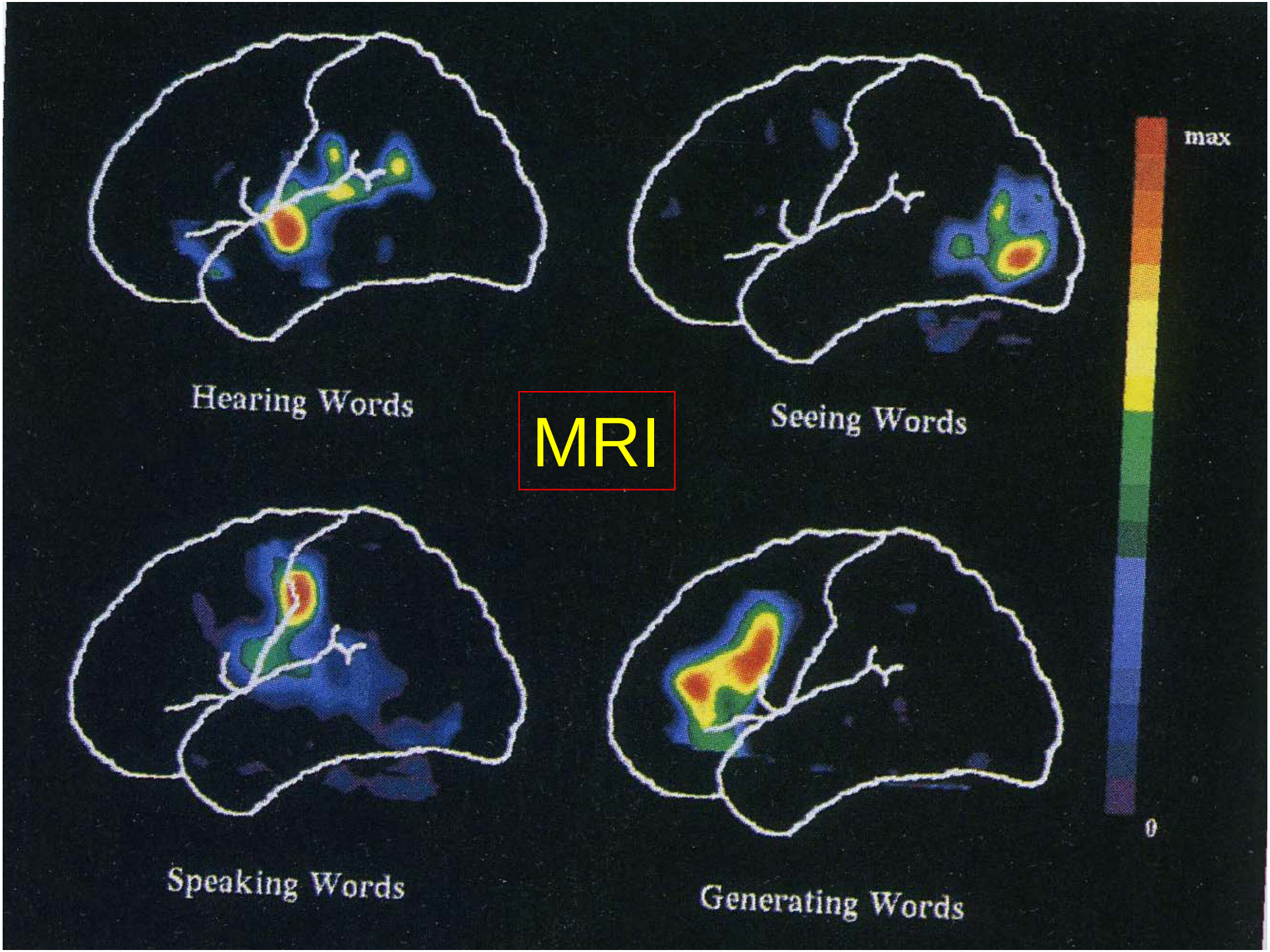
Speech learning requires specialized areas in forebrain



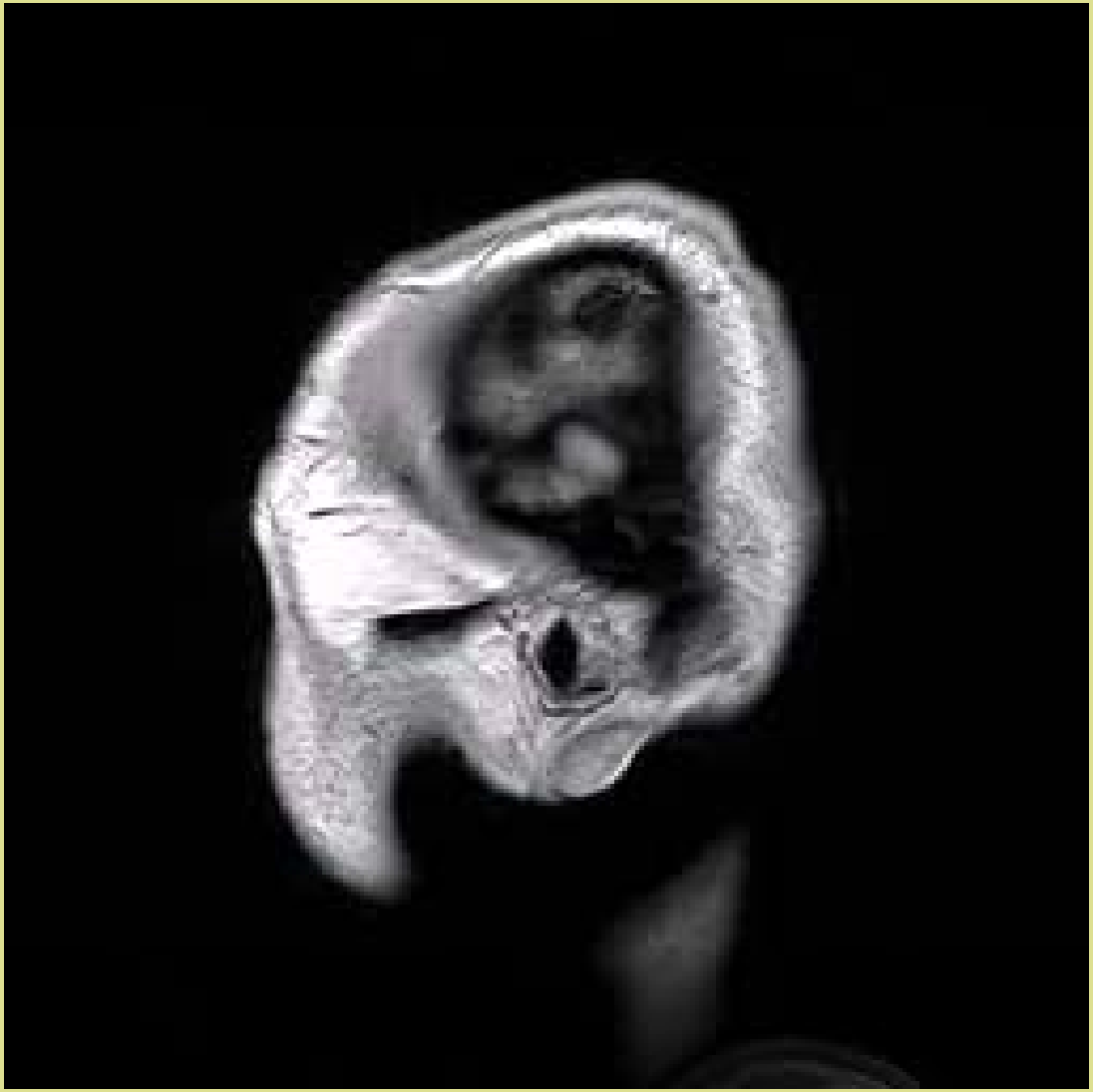


1. Broca's area: speech production
2. Wernicke's area: understand speech


Motor cortex
Somatosensory cortex
Motor control of lips and tongue
Wernicke's area
Visual processing
Angular gyrus
Primary visual area
Face recognition
Olfactory bulbs
Broca's area
Auditory cortex


Hearing Words
Seeing Words
MRI
Speaking Words
Generating Words
max
0

MRI to identify the neural activity in the brain



Are there innate components in speech learning/ language?

Innate components of language

Sound generation (consonants; vowels)

Innately recognized consonants

Innately processed vowel

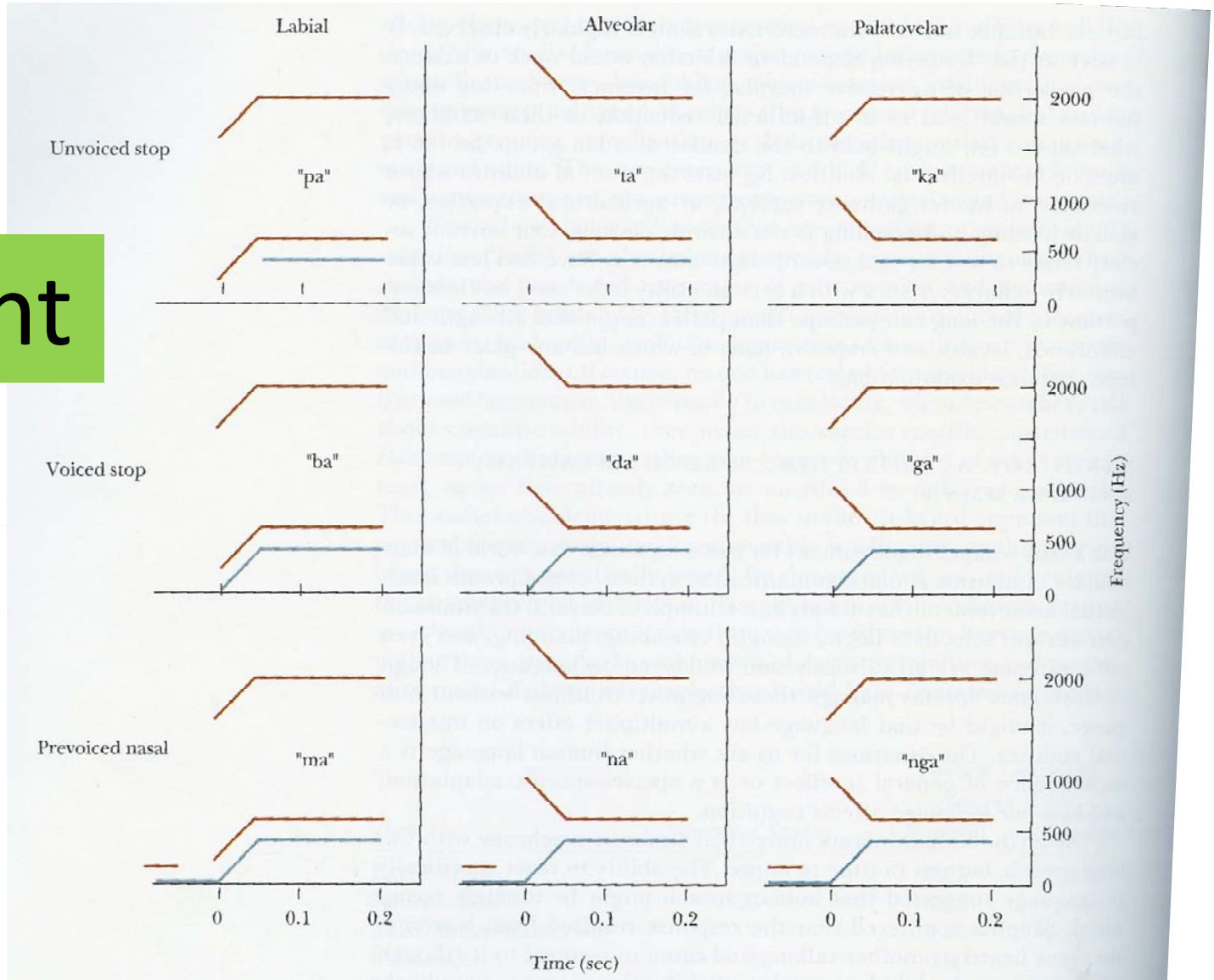
a **vowel** is a speech sound, such as English *ah!* [ɑ ː] or *oh!* [oʊ], pronounced with an open vocal tract vibration.

a **consonant** is a speech sound that is articulated with complete or partial closure of the vocal tract.

Syllable (vowel + consonant)

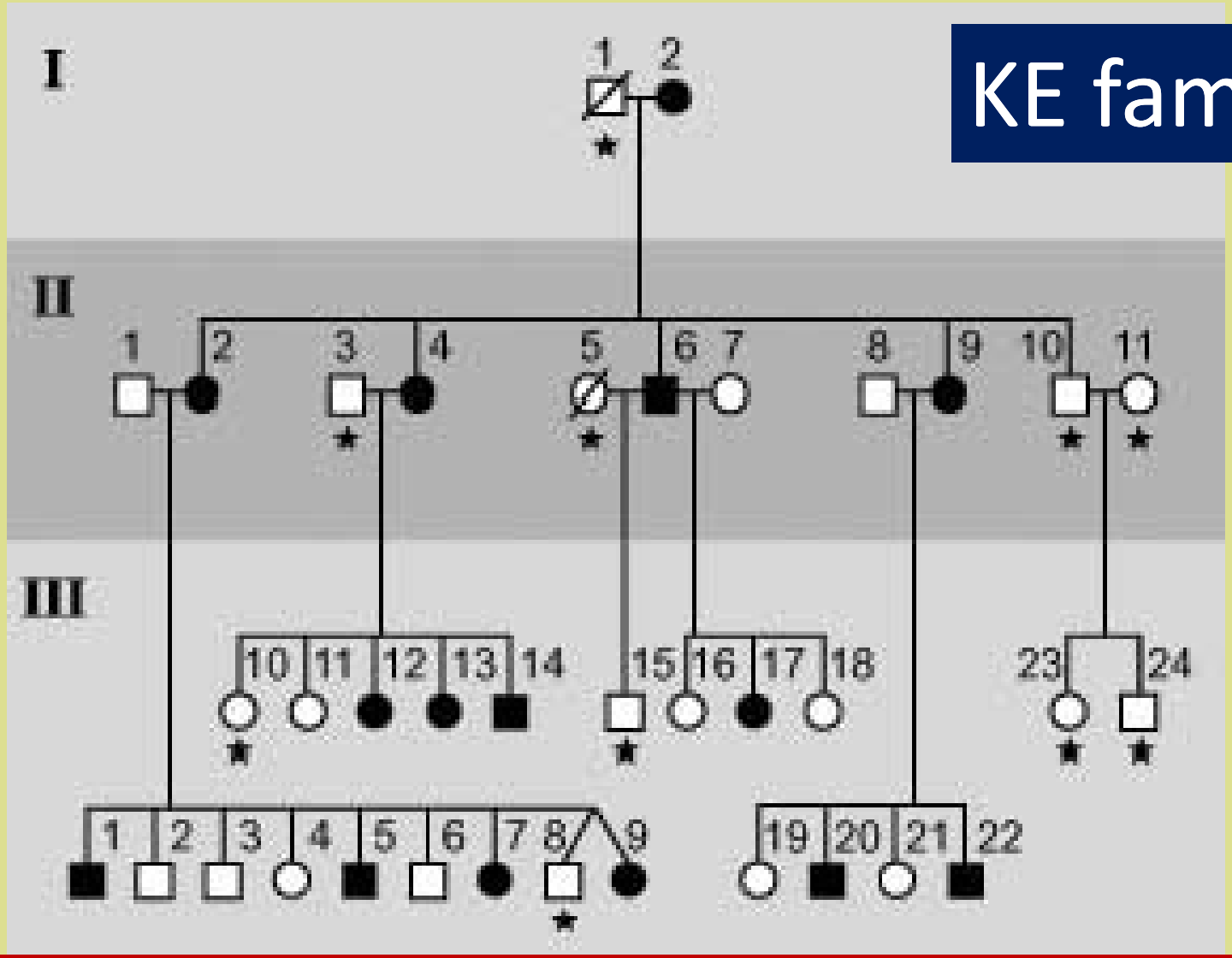
Word (syllables)

consonant



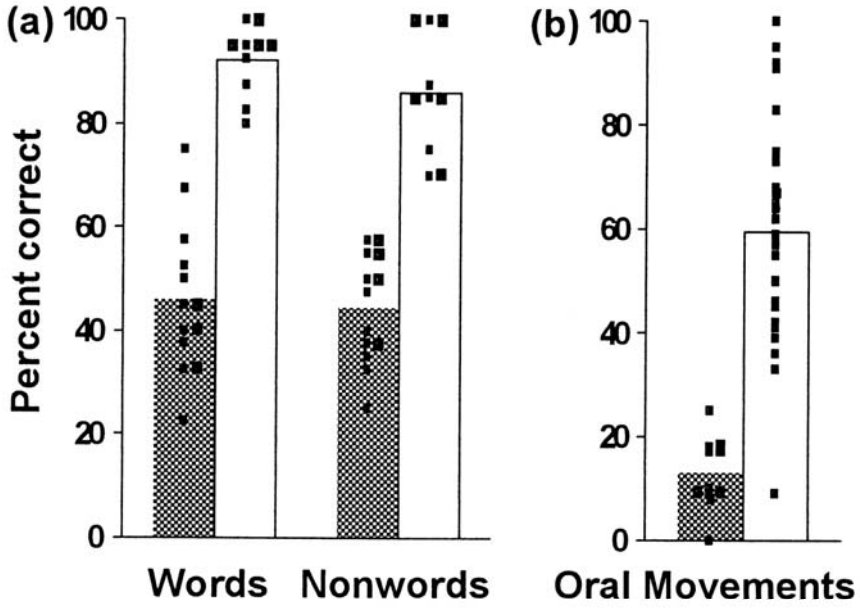
These nine consonants are distinguished by the location in the mouth where the airflow is manipulated (the labial, alveolar, and palatovelar groups) and the relative timing of the airflow change and the voicing of the vowel in the throat (prevoiced, simultaneous voicing—"voiced"—and delayed voicing—"unvoiced"). The airflow manipulations mainly alter the form of the second and third "formants" (the upper two lines in these sonographs), while the timing of voicing is reflected in the lowest (first) formant, shown in blue.

Genetic basis of speech learning?



Genealogical tree of the KE family. Black shapes represent persons with specific language impairments. Circles represent females, and squares represent males.

Q#1: According to the KE family speech test results below, on which test(s) did the unaffected group do better than the affected group?



I. Words
II. Nonwords
III. Oral Movement

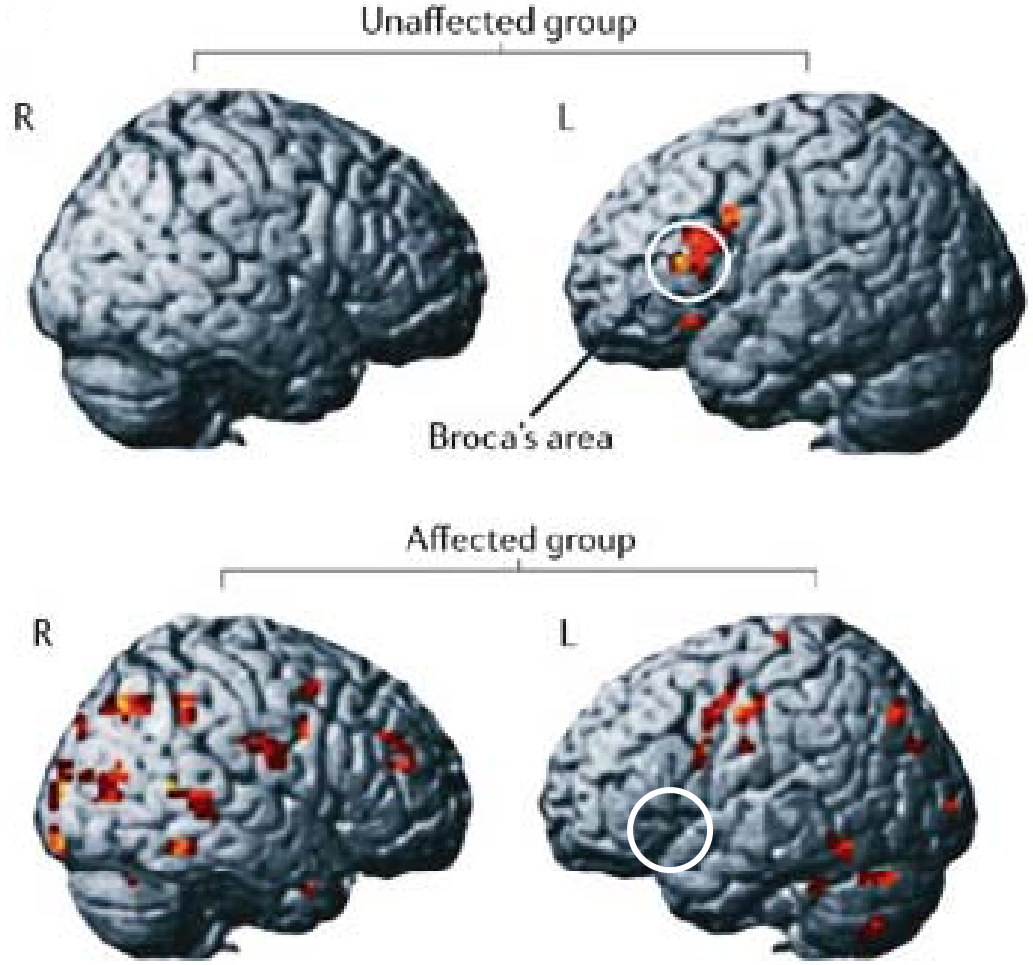
A. I
B. I, II
C. I, II, III
D. I, II
E. None of the above

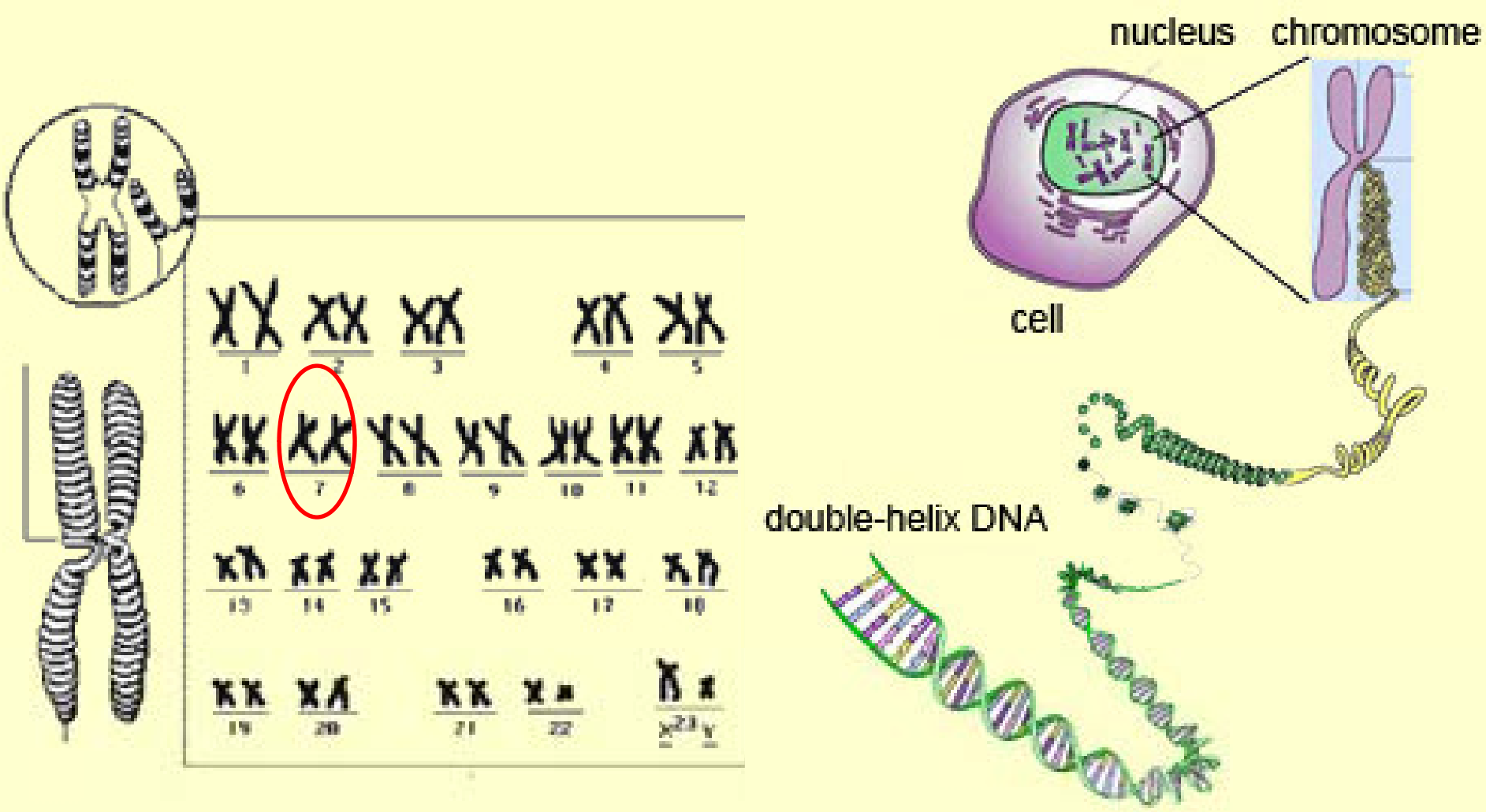
Affected group

Unaffected group

Vargha-Khadem F et al. PNAS 1998; 95:12695-12700

Neuroimaging of the KE Family Members



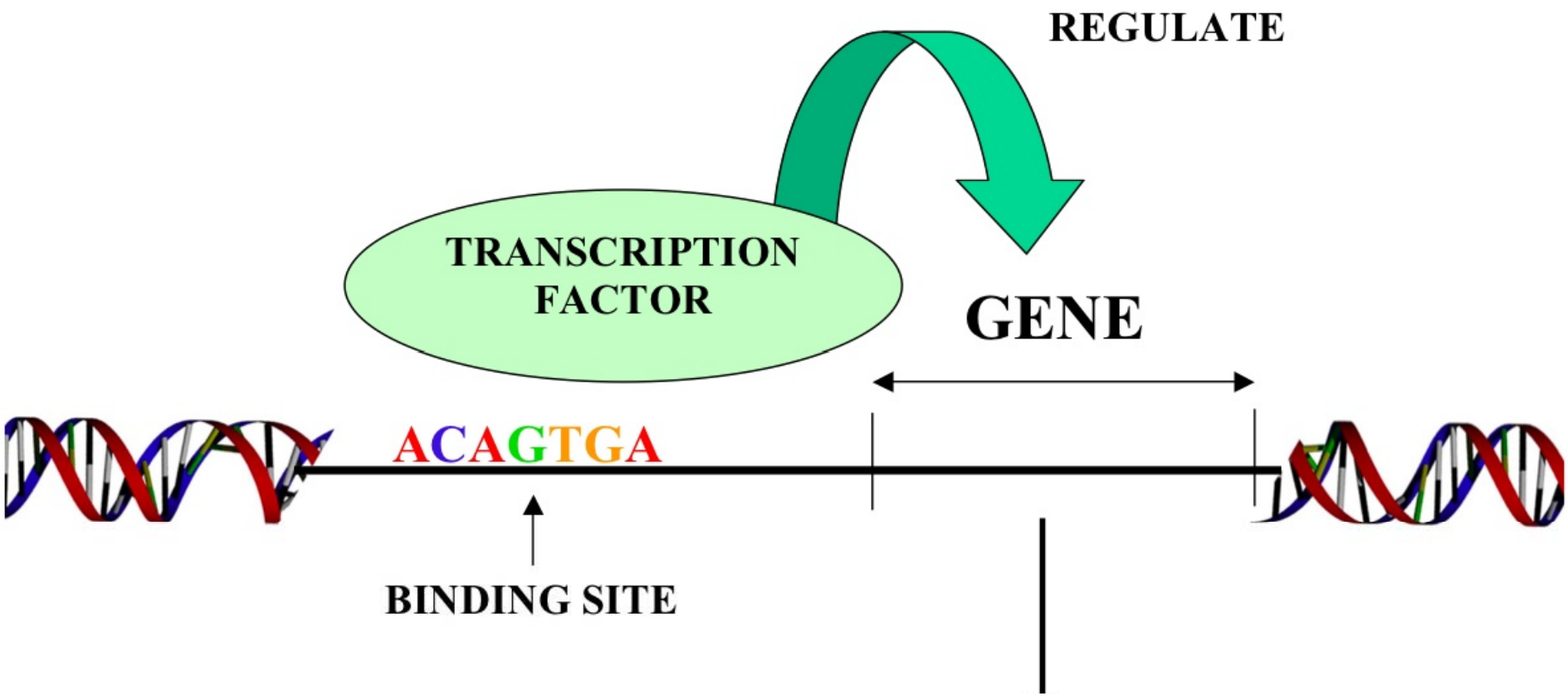


KE family with speech learning impairments
-- defects in Chromosome #7

Genetic basis of vocal learning

FoxP2 gene: Forkhead box protein P2

FoxP2 is a gene coded for transcription factor



Q#2: FOXP2 protein is found in certain but not all brain cells in the same individual; how is this possible?

A. Some brain cells don't have Chromosome 7.

B. *FOXP2* DNA is only present in some brain cells.

C. Some brain cells don't have ribosomes.

D. *FOXP2* mRNA is only produced in some brain cells.

E. Some brain cells contain more DNA.

Learned vocalizations in humans

1. Rare evolutionary event
2. Require auditory experience
3. Require sensitive period of development
4. Require "babbling" error-correction stage
5. Require a specialized brain area
6. Innate components of learning
7. Associated with specific genes
8. why evolve language?